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Addicted to Cigarette (Sales): Taxing the Native American Cigarette Trade

by

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Honors Thesis

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Addicted to Cigarette (Sales):
Taxing the Native American Cigarette Trade

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ABSTRACT: In order to close a budget deficit, New York State raised its cigarette tax in 2010 to \$4.35 per pack. Included in this legislation was a removal of the exemption of cigarettes sold on Native American Reservations from the tax. This paper develops a model of cigarette demand that focuses on measuring cross-price elasticity of demand in order to ascertain the effect of state-level taxation on the sales of Native American cigarettes in New York. The model indicates that reservations will lose about 79% of their cigarette business, and that New York State will raise about \$447 million dollars more each year than they would have if Native American sales remained exempted. The paper also discovers that omitting border-state prices in a cigarette consumption model will create an omitted-variable bias, making the effect of home-state price elasticity appear smaller than it actually is.

Keywords:

JEL Classifications: H2, H3, H7, I1

Addicted to Cigarette (Sales): The Effects of Taxing the Native American Cigarette Trade

Introduction

The fiscal stress of recent years has prompted state governments across the country to increase the excise tax on cigarettes. Since 2008 alone, the average increase in state cigarette taxes nationwide has been over 21 cents. Cigarettes taxes have long been viewed as an attractive revenue source on two counts. Smoking imposes health-related negative externalities upon society, and cigarettes are inelastic, meaning cigarette taxes are an effective revenue source. According to Murphy (2006) the real average state excise tax increased 109% from 1990-2003. This trend continued throughout the past decade, and cigarette tax receipts have risen accordingly: since 2000, state cigarettes tax collections have increased by 66.7%¹.

On July 1, 2010, New York State raised its cigarette tax from \$2.75 to \$4.35, making New York the highest-tax state in the nation. Beyond this substantial tax increase the new legislation included a provision that removed the long-time exemption from the excise tax for cigarettes sales on the reservations of Native Americans throughout the state. Earlier efforts to tax Native American sales has been controversial and not without incident. In 1997 the Seneca Nation shut down the New York State Thruway to protest the same proposed tax on their cigarettes. The reaction resulted in tire fires on the highway, minor fights, and injuries to police officers. A coalition of tribes, led by the Seneca Nation in the Southern Tier, waged a successful legal battle against tax collection that prolonged the Native American's special tax treatment until the most recent legislation. Collection of the excise tax on reservations began on June 21, 2011. The ramifications of this new tax on reservations are, at best, uncertain and potentially dramatic.

¹ In this study, the District of Columbia is considered a state.

Reservations depend heavily on purchases from New York customers to provide employment and commerce to an otherwise fragile economy.

According to state budget documents (see Kriss 2010), the state of New York expects to raise \$440 million in new revenue from the tax increase, with \$150 million coming from the new tax on Native American reservations. However, it is important to assess to what extent this additional state revenue comes at the expense of commerce on Native American reservations. On one level one might surmise that, since cigarette demand is generally regarded as inelastic, the burden of the new tax falls predominately on the purchaser and thus the net-tax revenue received by Native Americans may not be substantially reduced. However, this reasoning is superficial because the determining factor in ascertaining the effect on Native American sales is *cross-price* elasticity, not own-price elasticity of cigarettes. The historical tax exemption has obviously lowered the relative price of cigarettes for on- versus off-reservation sales, and eliminating the exemption closes this gap. Although the literature has amply documented that the price elasticity of demand for cigarettes is generally inelastic, this does not mean that the demand elasticity will be low on an inter-regional basis when significant relative price differences exist. If the cross-price elasticity between more narrowly defined geographic areas is high -- in this case, between on- versus off-reservation sales -- then the price elasticity of demand for Native American purchases will be higher. This would imply that the revenue losses on reservations will be substantial.

This paper develops a model of cigarette demand that focuses on measuring cross-price elasticity of demand. Estimation of this model is accommodated empirically by the fact that cigarettes taxes, and thus gross cigarette prices, have differed substantially between states. A

key element of the model is the estimation of cross-price elasticity based on the integration of relative price differences across states and the degree of "border contiguity" of these states.

Literature Review

While there is a large literature on the price elasticity of demand for cigarettes, there has been relatively little analysis of cross price elasticity as it pertains to cross-border purchases of cigarettes that may be prompted by differences in the price of cigarettes in different states. These price differences can be substantial since much of the price of cigarettes reflects an individual state's choice of the tax that is levied. For example, Washington, D.C. and Virginia have vastly different tax rates (DC's rates over the past ten years range from 65 cents to 250 cents, while Virginia's rate ranges from 2.5 cents to 30 cents), incentivizing D.C. residents to purchase cigarettes in Virginia. Knowledge of the magnitude of this cross-price elasticity is key to estimating the likely loss in revenue to Native Americans due to New York's recent legislation eliminating the tax exemption on cigarettes sold on reservations.

Estimates of the price elasticity for cigarettes have varied widely. In a meta-analysis, Chaloupka and Warner (2000) found cigarette price elasticities over a range of .14 to -1.23, although the results of most studies fall between -.3 to -.5. Another meta-analysis by Gallet and List (2003) confirmed a large variation in estimates. They identified a range of -3.12 to 1.41 around a mean of -.48.

Based on data for the period 1955-1985 Becker, Grossman, and Murphy (1990) estimated a short-run price elasticity of cigarettes of -.4 and a long run elasticity of -.75. A subsequent study by Murphy (2006) found a slightly lower long-run price elasticity of -.6. Notably, Murphy's analysis used an earlier vintage of the state-based data set for this study. Jackson and Saba (1997) built upon the work of Becker, Grossman, and Murphy but incorporated a model

that determined how many people in a given state will bootleg cigarettes across state borders. Their model included variables measuring the length of state borders, the geographic area of a given state, and total state population to determine how far an individual would be willing to drive to purchase cigarettes in a different state. The study resulted in a short-run price elasticity of $-.31$ and a long-run price elasticity of $-.56$.

Baltagi and Goel (2004) examined 336 state tax changes over the period 1956-1997. These data indicated an even lower long-run price elasticity of $-.32$. They also concluded that the price elasticity has declined over time. Part of Baltagi and Goel's contribution lies in their effort to account for cross-border bootlegging of cigarettes, although they found that cross-border purchases did not significantly affect elasticities. However, they noted that elasticities demonstrated “sensitivity to border-effect purchases [which] highlights the loss in revenue to neighboring states.”

A recent paper by Lovenheim (2008) also controlled for the smuggling of cigarettes across state borders in an effort to better estimate the price elasticity of demand, noting that excluding smuggling effects will create an example of “omitted variable bias”. To estimate the impact of smuggling, Lovenheim considered the distance of different Metropolitan Statistical Areas from the borders of states with lower-price cigarettes. An interesting finding of this study was that home-state price elasticities were *not* significantly different from zero until cross-border purchases were taken into account. Once cross-border purchases are controlled for, the “full price elasticity” increases to a number more in line with previous research suggesting that in the absence of cross-border purchases cigarette sales would be more responsive to price changes. My study augments Lovenheim's by attempting to quantify the cross-price elasticity of the

“most-contiguous” border states to a given home state, and ultimately comes to a similar conclusion.

Lovenheim also applied his research to examine the optimal tax level in each state. Since states that have populous borders are more likely to be sites of cross-border purchases, states that are small and densely populated (such as Rhode Island, D.C., and Delaware), or simply have much of their population near the border of another state (such as Nevada and Wyoming), should aim for tax rates lower than the national median in order to maximize revenue. That way, these states can make sure that their own citizens purchase in-state and out-of-state consumers may be enticed to cross the border to obtain cigarettes. On the other hand, states with only a small percentage of their population on the border (such as Texas) should have high tax rates to maximize revenue since sales in those states are unlikely to be affected by cross-border purchases. The same idea goes for the federal government: since an across-the-country tax increase will not impact smuggling incentives (except perhaps in regards to Mexican border states), the federal government should maintain a high excise tax rate to raise revenue and decrease smoking rates.

Connelly, Goel, and Ram (2009) examined cross-border smuggling on an international level based on cigarettes purchases between the U.S. and either Canada or Mexico. They found that cross-border sales with Canada does not affect sales in contiguous U.S. states while states bordering Mexico did have significantly lower sales due to cross-border price differences. This study is especially relevant to this paper because it specifically estimates a cross-price elasticity of cigarettes due to regional price differences. Connelly et al. obtained a cross-price elasticity of 1.43. However, the modeling behind this estimate is arguably too narrow because it only considers one border state, which is the lowest-priced state, for each home state. This modeling

thus ignores two facts -- some states have more cross-border options and some borders are more important than others to a particular home state. For example, even if Vermont has lower-priced cigarettes than New Jersey, it is plausible that the New Jersey price will have a greater impact on New York cigarette sales because the New Jersey border is more populated than the Vermont border. The present study considers price differences with respect to two and three border states. The model in Connelly et al. also produced a suspiciously high price elasticity of demand of -1.84, a finding clearly at odds with prior research. The authors attribute some of this result to the effect of controlling cross-border purchases, a finding consistent with Lovenheim (2008). Even so, a value of -1.84 seems very high in the context of the literature.

As is the case with cross-border purchases, there has not been much investigation of the economic impact of Native American Indian sales. This is probably because the problem is an issue limited almost entirely to New York; very few states do not tax Native American cigarette sales and none are as affected by sales as New York. As stated above, the state estimates it will raise \$150 million a year from taxed sales. However, this number stands in stark contrast to the study by Brian O'Connor the state used to generate the estimate. O'Connor (2009) estimated the state of New York could raise \$1 billion from taxing Native American sales. Many media reports also put the number at around \$1 billion. Falling between these starkly different numbers, in 2007 State Senator Jeffrey Klein released a report claiming the state could gain \$270 million, or \$284 million in 2010 dollars, from taxing reservation sales. In 2010, Klein was quoted suggesting the state will raise about \$500 million from reservation sales in 2011 (Smith 2010).

Though peripheral to the focus of the present study, the income elasticity of cigarettes is still relevant because the population in and around New York Native American Reservations is

considerably poorer than other areas of the state. Gallet and List's (2003) meta-analysis found no general agreement on the income elasticity of demand, the mean elasticity is .42 with a standard deviation is .49.

Model

The focus of this paper is to evaluate the quantity of state-level per capita cigarette consumption with respect to both home-state and neighboring-state price movements. Equation (1) presents the basic demand model:

$$(1) \quad \ln(Q_{it}) = \beta_0 + \beta_1 \ln(P_{it}) + \beta_2 \ln(P_{jt}) + \beta_3 \ln(P_{kt}) + \beta_4 \ln(P_{lt}) + \beta_5 \ln(I_{it}) + \beta_6 \text{Time} + \beta_7 \text{State}$$

Hypothesized sign: $\neq 0$ < 0 > 0 > 0 > 0 $\neq 0$ < 0 N/A

where Q_{it} = per capita packs of cigarettes sold in the i th home state in year t ;

P_{it} = average price of a pack of cigarettes in state i in year t ;

P_{jt} = average price of a pack of cigarettes in contiguous state j in year t ;

P_{kt} = average price of a pack of cigarettes in contiguous state k in year t ;

P_{lt} = average price of a pack of cigarettes in contiguous state l in year t ;

I_{it} = per capita income of state i in year t ;

Time = time trend;

State = fixed effects binary of for each state.

Following Lovenheim (2008) and Connelly et al. (2009), the basic demand model attempts to measure the effect of cross-border price differences on the demand for cigarettes in a home state. However, Equation (1) incorporates the fact that most home states have multiple contiguous states, thus the model includes the case of the two and three "most" contiguous states. The degree of "contiguity" is measured by an index, the construction of which will be discussed shortly. Because the model considers a home state's multiple contiguous states, the sample of

states is not 51 (data were available for Washington DC so it was treated as a “state”). Only 43 states have at least three neighbors (Alaska, the District of Columbia, Florida, Hawaii, Maine, Rhode Island, and South Carolina are excluded). The criterion of two contiguous states in the model expands the sample to 48 (only Alaska, Hawaii and Maine are omitted).

The model includes "fixed-effects" binaries for all states to control for differences in cigarette consumption across states that may exist but do not differ significantly over time between states (e.g., educational attainment, statewide attitudes towards smoking).² State fixed-effects binaries have previously been used in the cigarette elasticity literature³ (see Cheng and Kenkel 2010). A time-trend variable is included to capture any non-state specific changes in the preferences for cigarettes over time.

Consistent with the literature (Gallet and List: 2003), a double-log model was chosen to readily accommodate an interpretation of elasticities. Equation 1 was also estimated as a first-difference model but the state binaries obviously disappear since, by assumption, there are no variations in the "fixed effects". The first-difference model was run in both the 43 and 48 state samples and with three and two cross-price variables, respectively.

The expected signs in the first four parameters in Equation (1) are straightforward. The price elasticity of demand should be negative while all cross-price elasticities should be positive because cigarette consumption in the home-state should rise with an increase in the price of substitute cigarettes in a border state. Year was hypothesized as negative because cigarette consumption has fallen over time as the health hazards of smoking have been more widely

² The likelihood of state-specific differences in the preference for smoking is reflected in the fact that states have restricted smoking in restaurants and public places at vastly different times; such as California in 1995, New York in 2003, and Virginia in 2009)

³ Unfortunately, there was not room to include a “Mexico border” binary for each state in this paper (as Connelly, Goel, and Ram [2009] suggest is appropriate) because this study incorporates fixed-effects binaries at the state level.

accepted. Per-capita income was included as a control variable but which no predicted sign was posited. Previous research has found positive and negative values⁴.

Table 1: Descriptive Statistics of Variables

Variable	Mean	Min	Max	Std. Dev.
Price	118.42	55.35	343.96	48.41
State 1 Price	121.64	58.04	343.96	51.39
State 2 Price	118.77	55.35	343.96	48.06
State 3 Price	118.40	55.35	349.47	47.89
Year	1989.5	1969	2010	12.12
Per Capita Income	13569.23	6255.04	26800.90	3191.36

Notes: All values deflated to 1982-1984 dollars. These stats were created using the 43 state data set. Values for prices are in cents.

Annual per capita cigarette pack sales of each state, the annual average price of a pack of cigarettes in each state, and annual state tax levels from 1969-2010 were obtained from the 45th volume of the annual publication of The Tax Burden on Tobacco by Orzechowski & Walker[†] (for more information on a given source find the corresponding data file in the ‘sources’ section at the end of the paper). The per capita income of each state was obtained from the United States Regional Economic Analysis Project[‡]. Measures of border county and state populations were

⁴ Income elasticities have been found to be both positive and negative with a wide range according to the meta-analyses by Chaloupka & Warner as well as Gallet & List

obtained from the U.S. Census Bureau's 1989⁵ Census estimates^{!!}. Inflation figures were provided by the Federal Reserve Bank of St. Louis*.

The broad contribution of this study is to expand the analysis of cross-price elasticity in the literature. Specifically, this is done by more carefully measuring the degree to which states are contiguous since this factor should account for the cross-border consumption response to price differences. In other words, shared borders are not all equal in the case of price differences. For example, in the case of New York, many people live near New Jersey and Connecticut. In contrast, relatively few people live on the border between Massachusetts and New York. Thus, the price of cigarettes in New Jersey is “more important” than the price of cigarettes in Massachusetts to New York consumers.

Variation in the degree of contiguity was incorporated into the model first by constructing an index with which to rank states based on border population. This index was created by adding together the population of all counties on both sides of a border and dividing this sum by the total population in the given state:

$$(\text{Pop. of Border Counties}_i + \text{Pop. of Border Counties}_j) / (\text{Total Pop. of State}_i)$$

This construction for ranking the “most-contiguous” border state is very similar to Coates's (1995) method for establishing a variable called BORDER TAX, which was used to control for cross-border prices. The constructions are different in that Coates incorporates the tax rates of both states while this study uses the border state price. Additionally, Coates's study does not divide the population of the border counties by the total population of the home state. Dividing by the population of the home state is appropriate because it evaluates how important a given border is to a whole state. For example, a border county population of 400,000 people

⁵ Using only one year while creating a ranking of borders rather than reevaluate each border every year will produce results that may not be perfectly accurate across the data set, since certain border counties may become more or less populous compared to a state as a whole over the data set.

would be more important to a low-population state like Nevada than a high-population state like New York.

The resulting number is a weight that evaluates how important a given border is to a given state. It measures the percentage of people affected by a tax/price increase to the total population of a state. Because people on either side of a given border can easily buy cigarettes from either state and are thus impacted by a price increase of either state, the population along a given border in state j is important to sales in state i . The resulting index was used to obtain an ordinal ranking of each state's contiguous states. Again, consider the case of New York. New Jersey was designated as the most contiguous, Connecticut was designated 2nd most contiguous, Pennsylvania was designated 3rd most contiguous. Of course, Vermont and Massachusetts also border New York, but the estimation of Equation 1 is only performed separately using the three and two most contiguous states. It is appropriate to limit the number of contiguous states in the model because increasing the number of contiguous states reduces the total number of states that can be included. Recall, the model will be estimated for 43 states when considering three contiguous states and 48 when only the two most contiguous states are included⁶.

Results

Overall, the models found that cross-price elasticities and home price elasticities were significant in determining the volume of state-level cigarette pack sales. The models also mostly reinforced previous research, obtaining similar results to prior studies.

Table 2: State Price and Cross-Price Elasticities – Not Corrected for Serial Correlation

⁶ The weights were also run as values multiplied by the price in each contiguous state, but the results were not adequate and not included in the study. The weights perform better as an ordinal ranking than a cardinal weight.

Variables	Ln Levels Model			Ln First Difference Model		
	No Contiguous States	Three Most Contiguous States	Two Most Contiguous States	No Contiguous States	Three Most Contiguous States	Two Most Contiguous States
Price	-.720** (-40.16)	-1.086** (-24.88)	-1.143** (-27.47)	-.321** (-19.31)	-.548** (-21.19)	-.507** (-21.38)
State 1 Price		.244** (5.24)	.297** (6.68)		.160** (6.23)	.208** (8.70)
State 2 Price		.131** (3.15)	.179* (4.61)		.040* (1.55)	.072** (2.98)
State 3 Price		.071* (1.68)			.144** (5.78)	
Year	-.007** (-7.84)	-.001** (-8.33)	-.009** (-9.38)	-.001** (-9.61)	-.001** (-11.95)	-.001** (-11.49)
Per Capita Income	.287** (5.43)	.450** (8.70)	.281** (5.47)	.220** (5.20)	.192** (4.58)	.200** (4.84)
Intercept	20.16** (13.86)	26.65** (18.00)	22.32** (15.88)	2.05** (9.54)	2.432** (11.89)	2.41** (11.41)
R ²	.8810	.8944	.8881	.252	.3089	.2977
Adj. R ²	.8780	.8916	.8852	.251	.3066	.2959
F-Value	290.79**	310.00**	299.53**	220.53**	130.76**	166.22**
DW-Stat	.286	.330	.332	2.412	2.507	2.472

Note: Parentheses contain t-values; * indicate 5% significance level; ** indicate 1% significance level.
Levels model includes state fixed-effects binaries.

Table 3: State Price and Cross-Price Elasticities –Corrected for Serial Correlation

Variables	Ln Levels Model			Ln First Difference Model		
	No Contiguous States	Three Most Contiguous States	Two Most Contiguous States	No Contiguous States	Three Most Contiguous States	Two Most Contiguous States

Price	-.370** (-22.77)	-.566** (-21.13)	-.532** (-21.73)	-.321** (-19.31)	-.548** (-21.19)	-.507** (-21.38)
State 1 Price		.142** (5.37)	.188** (7.63)		.160** (6.23)	.208** (8.70)
State 2 Price		.015 (0.56)	.045* (1.79)		.040* (1.55)	.072** (2.98)
State 3 Price		.129** (5.01)			.144** (5.78)	
Year	-.016** (-19.32)	-.018** (-20.69)	-.018** (-21.33)	-.001** (-9.61)	-.001** (-11.95)	-.001** (-11.49)
Per Capita Income	.278** (6.46)	.264** (6.13)	.270** (6.39)	.220** (5.20)	.192** (4.58)	.200** (4.84)
Intercept	36.382** (27.87)	38.477** (28.69)	39.488** (29.93)	2.05** (9.54)	2.432** (11.89)	2.41** (11.41)
R ²	.8879	.8899	.8928	.252	.3089	.2977
Adj. R ²				.251	.3066	.2959
F-Value				220.53**	130.76**	166.22**
DW-Stat	2.248	2.363	2.301	2.412	2.507	2.472

Note: Parentheses contain t-values; * indicate 5% significance level; ** indicate 1% significance level.
Levels model includes state fixed-effects binaries.

Models were tested for positive autocorrelation using the Durbin-Watson test, resulting in positive serial correlation of the levels models significant at the 1% level, as can be expected with time-series data. Yule-Walker estimates were developed in SAS and are the results given in Table 3. The YW estimates are not affected significantly by serial correlation according to the Durbin-Watson test. The original estimates not corrected for serial correlation can be found in Table 2. As the first difference model did not test positive for serial correlation the OLS results are given in all tables.

As can be seen in table 3, the home state cigarette price elasticity of demand when cross-price elasticity is not considered is $-.37$, significant at the 1% level. This means that a 1% change of price in state i will result in a .37% decrease in consumption in state i . This implies that cigarettes are an inelastic good, which is logical considering their addictive quality. This result corroborates previous research: as cited above, the generally accepted range is $-.3$ to $-.5$.

What is most interesting is what happens to price elasticity of demand when the cross-price elasticity of border states is considered. As both Lovenheim (2008) and Connelly, Goel, and Ram (2009) note, price elasticity actually *increases* when cross-border purchases are controlled for. In this case, elasticity rose from $-.37$ to a range of $-.507$ to $-.566$, hitting Jackson and Saba's (1997) estimate of $-.56$ and Lovenheim's (2008) estimate of $-.527$ right on the head. This research supports Lovenheim's supposition that not including cross-border purchases is a case of omitted variable bias. In this case, the often-excluded variable (price of border-state cigarettes) positively influences taxed sales in state i . Its exclusion biases the included variable of cigarette price in state i upwards (here it is important to remember that price elasticity of demand is actually a negative value, so a lower absolute value is a greater value). This implies that over the course of the data set home state price and border state prices are positively correlated (if two right-hand variables are positively correlated and one is excluded the included variable will be biased upwards). Indeed, in all models, the home state price is strongly positively correlated with border state prices (see table 4 in the appendix). Thus, including cross-border purchases seems to be required to obtain accurate results when determining the price elasticity of demand of cigarettes. More discussion of this issue is included in the appendix.

As anticipated, all cross-price elasticity measurements were positive (although after correcting for autocorrelation the coefficient 2nd most important border state could not be deemed significantly different than 0). Most values range from -.10 to -.15, meaning that a 1% increase in the price of a pack of a border state's cigarette will result in about a .13% increase in the home state's sales. With the exception of the insignificant variable, in all cases the value and t-value of the coefficient of the cross-price elasticities decrease as observed from the most important border to the 3rd most important border. This average elasticity of .13 is dissimilar to Connelly, Goel, and Ram's (2009) estimate of a cross-price elasticity of 1.43. However, the value of .13 is more believable, since cross-price elasticities rarely exceed 1.

When controlling for cross-price elasticity income elasticities ranged from .192 to .270, with an average of .232, meaning that if income in state i increases by 1% cigarette sales in state i will increase by .232%. This is in line with the meta-analysis average of an income elasticity of .42.

Application $1.6/x * 100 = .72$

The results of this study generally indicate that the state of New York will raise a large amount of revenue by nominally increasing the cigarette tax \$1.60 and that Native American Reservations across the state will be decimated by the collection of the cigarette excise tax.

In 2010, New York State's average real per-pack price was \$3.44. In real terms, the 2010 tax increase will increase prices by \$.72. Taking into account the levels' model 43-state regression price elasticity of demand estimate of -.566 we have:

$$\text{Price Elasticity of Demand} = \frac{\Delta Q_d}{Q_d} * \frac{P}{\Delta P}$$

$$\text{Substituting in for obtained values this formula becomes: } -.566 = \frac{\Delta Q_d}{24.1} * \frac{\$3.44}{\$.72}$$

This produces a change of per-capita pack sales of -2.9, meaning New York's new per-capita packs sold value will be 21.2 packs purchased per year per person, *ceteris paribus*. Multiplying this figure by New York's 2010 population aged 14 and over of 15,610,138⁷ the regression predicts that there will be about 330,934,926 taxed cigarette packs sold in New York in 2011. At a tax rate of \$4.35 per pack plus 4% sales tax (\$4.72⁸), New York will collect \$1,561,880,477 in cigarette tax revenue.

In comparison, had the tax not been increased and New York's price stayed at \$3.44 (7.64 in nominal terms), 24.1 packs will be sold per-person, *ceteris paribus*. Multiplying this figure by New York's 2010 population of 15,610,138, the data predicts there would have been about 376,204,326 taxed packs sold in New York in 2011. At a tax of \$2.75 and sales tax of 4%, New York would have received \$1,149,529,939 in cigarette tax revenue. Subtracting this value from the predicted value found with the higher tax, it is predicted that New York will raise an extra \$412,350,538 by raising the state cigarette excise tax from \$2.75 to \$4.35. This number exceeds New York's estimate of raising \$290 million, as given by Kriss (2010).

The situation looks much bleaker for the Native Americans of New York. According to a representative from the New York State Department of Taxation and Finance, 233,490,520 packs were shipped to Native American Reservations in New York in 2010⁹. An article by the Tobacco Underground states that in 2008 on the Seneca Reservation a carton of cigarettes cost \$32, compared to \$60 off-reservation, making reservations 46.7% cheaper than convenience

⁷ This number comes from the population of New York in 2010 (19,378,102) multiplied by the percentage of residents who are 14 or over. The percentage of the population 14 or over is itself estimated assuming a uniform distribution of people aged 18 and under. A quarter of the population is 18 or under.

⁸ This comes from the 2010 price of $(\$3.44 + \$1.60 \text{ tax increase} * .04 \text{ sales tax}) + \$3.44 + \$4.35$

⁹ Since Native American retailers are under no obligation to divulge sales numbers to any entity, there is no definite statistic concerning annual sales on reservations. The value given is the total cartons wholesalers shipped to reservations, and will be assumed to be the total amount sold on reservations. The actual number is higher because some tribes manufacture a small number of their own cigarettes.

stores off-reservation. Assuming this trend continues¹⁰, the real price of a pack of cigarettes in 2010 in 1982 dollars was \$1.83. Since Native American sales were previously untaxed, instituting a \$4.35 tax rate is the same as a \$4.35 increase in price, which is equal to \$1.97 in 1982 dollars. Additionally, the state of New York levies a 4% sales tax (counties typically add on another 4%), bringing the total increase in price to \$2.04 in 1982 dollars. Using the price elasticity of demand of the 48-state regression, which is more appropriate than the 43 state-regression because Native American Reservations have only 1 border, we have the following formula¹¹:

$$\text{Price Elasticity of Demand} = \frac{\Delta Q_d}{Q_d} * \frac{P}{\Delta P}$$

$$\text{Substituting in for obtained values this formula becomes: } -.532 = \frac{\Delta Q_d}{233,490,520} * \frac{\$1.83}{\$2.04}$$

This gives an expected change in quantity demanded of -138,480,442 packs per year. However, since New York is the reservation's "most contiguous" border, it is predicted that the state's general tax increase will also affect Native American sales. Using the cross-price elasticity of demand formula we have:

$$\text{Cross-Price Elasticity of Demand} = \frac{\Delta Q_d}{Q_d} * \frac{P_{\text{New York pack}}}{\Delta P_{\text{New York pack}}}$$

$$\text{Substituting in for obtained values this formula becomes: } .188 = \frac{\Delta Q_d}{233,490,520} * \frac{\$3.44}{\$.72}$$

This gives an expected change in quantity demanded of 9,187,580 packs per year.

¹⁰ This assumption depends on 1) the prices on-and-off reservation increasing at the same rate from 2008-10, 2) that the price of a carton on reservation compared to the price of a carton off-reservation is proportional to the prices of packs on and off-reservation, and 3) this location being indicative of Native American prices statewide.

¹¹ All of the numbers on this page are functioning under the assumption the tax increase was enforced throughout 2011. Of course, this is not the case, and Native American sales spiked in the first half of 2011 as sales temporarily remained untaxed. The values could be used to predict sales in the year after the tax is enforced. Additionally, there has never been a cigarette tax increase in U.S. history even half as large as this increase, so there is a wider degree of uncertainty with these numbers than is immediately apparent.

We must also consider the sales on reservations lost to New York due to the price increase on reservations. We can find how many sales the reservations will lose by looking at the situation from New York's perspective, since it is New York demand that is being affected. Using the cross-price elasticity of demand formula we have¹²:

$$\text{Cross-Price Elasticity of Demand} = \frac{\Delta Q_d}{Q_d} * \frac{P_{\text{Reservations}}}{\Delta P_{\text{Reservations}}}$$

$$\text{Substituting in for obtained values this formula becomes: } .129 = \frac{\Delta Q_d}{24.1} * \frac{\$1.83}{\$2.04}$$

This gives an expected change in quantity demanded of 3.5 packs per capita per year, or 54,635,483 packs sold in New York that would otherwise have been sold on reservations. Added to the expected loss from the price increase on reservation and the expected gain from New York's price increase, the model predicts that New York Native Americans will lose in total 183,928,345 sales, meaning they will sell 49,562,175 packs in 2011. This is a loss of 79% of all Native American business. This number may appear high at first glance, but is not as shocking when the percentage of reservation sales going to non-residents is considered. There is little to no motivation for a non-resident to drive to a typically remote reservation to purchase cigarettes if there is no large price incentive.

The extra revenue the state will obtain through taxing reservation sales comes on two levels. The first is through directly taxing sales on reservations. Multiplying the expected sales by the tax rate of \$4.35 and sales tax of \$.34 (this number comes from reservations' 2010 price plus the excise tax of 8.42 and New York's 4% sales tax), New York can expect \$232,446,601 in new revenue from taxing Native American sales. The second way the state raises money is through repatriating sales from reservations. If all of the net sales reservations lost due to the

¹² In the context of this problem we will have to use reservations as New York's 3rd most contiguous state even though that is Pennsylvania.

cross-price elasticity effects (45,447,903 sales) were repatriated to the state of New York, the state would raise an extra \$214,514,102. Totaling both sources of revenue, it is anticipated the state of New York will raise \$446,960,703 from taxing Native American sales. This \$447 million estimate of new revenue splits previous research down the middle. This number is much higher than New York's official budget estimate of \$150 million, and also exceeds the state's 2011-12 estimate of \$135 million¹³ (see Megna 2011). On the other hand, the \$447 million estimate is dwarfed by O'Connor's (2009) estimate of \$1 billion in new revenue.

Overall, the state of New York is anticipated to gain about \$859 million (\$447 million from taxing Native American sales, and \$412 million from the statewide tax increase) in revenue, exceeding the state's estimate of \$440 million.

Conclusion

What is perhaps most troublesome for New York tribes is that these estimates represent a "best-case scenario" for the reservations. This is because reservations depend on cross-border cigarette sales more than any state used in this study, and thus may hemorrhage more sales to the New York and even Pennsylvania convenience stores. If reservations do not maintain a tax advantage over off-reservation convenience stores, there is no incentive for consumers to drive there to purchase cigarettes. To mitigate the losses from the coming taxation, reservation retailers have increased production of tribal-made cigarettes, which remain untaxed because the tax is collected at the wholesale level. On the other hand, sales losses on reservations may also be overestimated because

The state of New York enacted the tax increase without any substantive discussion of how the increase would affect tribal reservations, an oversight that should be corrected. This

¹³ These low numbers may have been influenced by anticipated legal challenges by the Native American tribes.

study suggests that New York tribes will lose approximately half of their cigarette sales in a best-case scenario. This will decimate the tribal economies that are so dependent on cigarette sales, and cause Native Americans on reservations to fall even deeper into poverty. The fact that the tax increase is so enormous and implemented at once rather than gradually will only exaggerate the effects of the excise tax collection.

Appendix

Table 4: Correlations of Home and Border State Prices

	Home State	Border State 1	Border State 2	Border State 3
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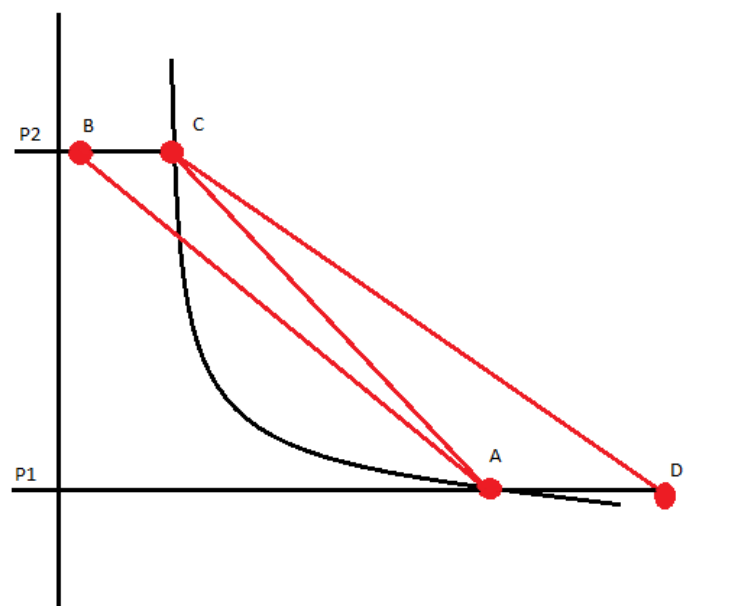
Levels Model – 43 States				
Home State	1			
Border State 1	.936	1		
Border State 2	.947	.941	1	
Border State 3	.945	.917	.930	1
Levels Model – 48 States				
Home State	1			
Border State 1	.936	1		
Border State 2	.939	.941	1	
First Difference Model – 43 States				
Home State	1			
Border State 1	.698	1		
Border State 2	.701	.704	1	
Border State 3	.702	.694	.685	1
First Difference Model – 48 States				
Home State	1			
Border State 1	.700	1		
Border State 2	.708	.708	1	

Discussion of Omitted Variable Bias

As discussed above, the exclusion of some measure of border state prices or out-of-state/smuggling sales will cause a cigarette price elasticity of demand model to be underfitted, biasing the

price elasticity value upwards. This may seem counterintuitive, since a simple supply/demand curve would suggest that not controlling for cross-border prices will bias the value downwards. See below:

Diagram 1: Price Elasticity of Demand, State i



Assume this is the demand curve of cigarettes for state i, a state that borders state j. Also assume both states begin with the cigarette pack price (P_1), meaning that there is no incentive for cross-border purchases. If state i increases its tax by 20 cents, the price moves from P_1 to P_2 and makes state j's cigarettes cheaper than state i. This will cause some consumers in state i to purchase cigarettes from state j. This will move the observed quantity demanded by state i from point A to point B instead of point A to point C, which is where demand would have moved had cross-border purchases not been possible. If cross-border prices are not controlled for, the additional movement of A to B instead of A to C will be attributed to the price elasticity of demand. Thus, the observed price elasticity of demand will be more negative (more elastic) than it really is. If state i were to lower its price from P_2 to P_1 and border state prices were not controlled for, an opposite situation will occur, which will result in the new point being point D instead of point A. Again, the observed elasticity will be more negative (more elastic) than it

truly is. Despite these effects, it seems as though the omitted variable bias is stronger, and underfitting the model will bias the elasticity value upwards.

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